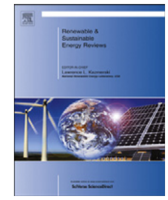
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Knowledge management mapping and gap analysis in renewable energy: Towards a sustainable framework in developing countries

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ABSTRACT

This paper presents a mapping of knowledge management in renewable energy (RE) promoted through international and regional organizations with emphasis on gap analysis for the purpose of increasing RE deployment in developing countries. The knowledge mapping showed that most efforts are focused on RE information sharing and awareness raising, followed by policy assistance and technology transfer. Priorities seem vague with minimal close implementation, coordination, and evaluation whereby technology transfer and capacity building efforts do not always cater to the needs of benefiting countries with a lack of specialized RE financial mechanisms that provide incentives for countries to invest in RE. Equally significant, limited efforts are discerned about joint research initiatives with a slow progress towards standardization and certification of RE technologies. A general framework is proposed with a definition of short, medium and long-term undertakings towards increased RE penetration in developing countries. The profile of well-positioned organizations to adopt such a framework is identified on the basis of a SWOT analysis.

Contents

1. Introduction

Renewable energy (RE) has had its uprising concurrently with rising concerns about climate change and associated implications. Much effort to substitute or supplement current energy trends with sustainable RE resources can be readily discerned through the implementation of various RE related projects [1–4]. Recent estimates indicate that RE provided ∼12.9% of the total primary energy supply in 2008 [5] and accounted for ∼16% of the world final energy consumption in 2010 [6] with a potential that can rise to 50% of the global energy demand by 2050 [7]. Low to middle income developing countries are equally attempting to deploy RE technologies and exploit associated environmental and economic benefits [8–12]. Many of these countries, however, are faced with a series of barriers that preclude RE from market penetration including a lack of information sharing and awareness, a lack of regulatory frameworks, a restricted access to RE technologies, a high up-front investment cost or a lack of access to capitals, a lack of standards and certification, a lack of skilled professionals and training facilities as well as trade barriers and unstable macro-economic environments [13–18]. As these

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barriers are 'rooted in or can be explained by knowledge barriers' [19,20], organizations of knowledge facilitation and exchange ought to play an important role in easing these constraints. Such entities contribute to RE knowledge exchange and technology deployment in developing countries through information dissemination, technology transfer and policy assistance for the facilitation and promotion of enabling environments for RE market penetration. While research on RE knowledge, resources, potential and barriers is plentiful at the local and national levels [19,8,21,2,11,12], limited work has assessed the role of international, regional, and at times national organizations in tackling RE knowledge barriers. This paper reviews the scope and scale of knowledge disclosure and dissemination by major players in the RE sector through a comprehensive mapping of their worldwide related activities. It brings forward an analysis of gaps in the international, regional, and local systems for the enhancement of RE collaboration, accessibility, and deployment particularly in developing countries. The paper concludes with a general framework that can assist in setting the future road map for RE knowledge management followed by a SWOT (strengths, weaknesses, opportunities and threats) analysis to define the type and role of organizations to adopt such a framework.

2. Methodology

A comprehensive critical review was conducted to identify active entities in the RE sector at various levels. The resulting data and information were synthesized and critically examined to establish who the main entities in RE knowledge creation are, what type of knowledge is being shared and through what forms and means. Nine indicators (Table 1) were defined to assess and map RE knowledge and how it is being managed as well as to analyze existing gaps. The knowledge mapping and gap analysis were used to develop a general framework of short, medium and long-term tasks to enhance RE penetration. A SWOT analysis was then performed to identify the relevant profile of an international body to assume the leading role in advancing this framework. The SWOT consisted of (1) short listing potential organizations or types of organizations with required scope and scale of work, (2) assessing the performance of these entities identifying strengths and weaknesses, and (3) defining the optimal organization profile for leading efforts towards enhanced RE deployment in developing countries.

3. Results and discussion

3.1. Knowledge mapping

Based on its source and application, RE knowledge can be classified under three levels: global, regional and country. Accordingly, the main entities in RE include a wide range of governmental organizations, networks and partnerships, financial and research institutions, regional organizations and initiatives, and private sector representatives. While these classifications are used to facilitate the approach and discussion of RE knowledge mapping, the three levels are intertwined and practically inseparable. Global knowledge is transferred regionally and locally through awareness raising, information sharing and exchange, capacity building efforts as well as technology transfer to be acquired, understood, adapted and used at the local level where it becomes localized. In parallel, local knowledge becomes globalized when it is published or made accessible through information technology. The contribution of the main RE entities in producing, building, sharing and exchanging knowledge related to RE at the various levels is summarized in Table 2.

Mapping of RE knowledge generation and exchange among regional and international key players reveals that nearly half of identified organizations are significant contributors to RE knowledge (Fig. 1), although by far, knowledge exchange efforts are concentrated on information sharing and awareness raising. While most information sharing is related to available technologies and examples of best practices and to a lesser extent on policies and incentives, there are specialized networks whose main mandate is to collect, analyze, update and disseminate RE related information, knowledge and practices (i.e. REEP; REN21; UN Energy; IRENA). The majority (90%) of these organizations allow public access to their information consisting mainly of reports, newsletters, policy briefs, guides, and manuals etc. While the sharing of such tools, contribute indirectly to capacity building (CB), key actors exert also direct efforts towards CB in the form of workshops, training, and education (i.e. Global Renewable Energy Education and Training Program). Concurrently, focused training, technical assistance, dissemination of best practices and lessons' learnt, as well as the funding of sustainable energy pilot and demonstration projects constitute the main forms of promoting technology transfer and enhancing local competence in and uptake of RE technologies. Financial institutions fund projects through multiple financing instruments particularly available to

Table 1
Indicators used for knowledge mapping and gap analysis.

Indicator		Refers to
A	Information sharing and awareness raising:	Collection, analysis and dissemination of RE related information and knowledge and awareness raising on benefits and potential of RE
A1	- Policies	
A2	- Technologies	
A3	- Best operational practices	
B	Policy advice and assistance	Policy advice, policy assessment and review; policy assistance; international exchange on RE policy
C	Technology transfer	Transfer of technology through demonstration projects, funding, pilot projects, grants
D	Capacity building	Training, workshops, educative material, expert support, exchange visits
E	Financing mechanisms	Financial support for RE investment, deployment, and use
F	Research and Development	Joint research and cooperation
G	Technical standards, certifications	National and international codes
H	Global agreements (Kyoto, etc.)	Involvement in RE related agreements
I	Regions of action	Africa, Af; Asia, A; Asia-Pacific, AP; Balkans, B; Latin America, LA; Caribbean, C; Pacific, P; Europe, E; Island states, SIS; Economies in transition, T; Member states, M; Middle East North Africa, MENA

Table 2
Scope of activities of main actors in renewable energy.

Type	Institutions	A1	A2	A3	B	C	D	E	F	G	H	I
International governmental organizations	Food and Agriculture Organization (FAO) [22]	X	X	X			X		X			AP; E; A;C; LA
	International Energy Agency (IEA) [23]	X	X		X	X	X				X	M
	United Nations Development Program (UNDP) [24]	X	X	X	X		X	X			X	C; Af; A
	United Nations Environment Program (UNEP) [25]	X		X		X	X	X	X	X	X	LA; C; E; Af
	UN Educational Scientific & Cultural Organization (UNESCO) [26]	X		X	X	X	X					SIS
	UN Industrial Development Organization (UNIDO) [27]	X	X			X	X		X		X	
	World Meteorological Organization (WMO) [28]	X	X	X	X	X	X		X	X		T
	International Renewable Energy Agency (IRENA) [29]	X		X	X		X	X				Af, P
International networks and partnerships	Global Bio-energy Partnership (GBEP) [30]	X			X			X	X		X	M
	Global Forum for Sustainable Energy (GFSE) [31]	X		X		X						E
	Global Village Energy Partnership (GVEP) [32]		X	X	X		X	X				M
	Global Alliance for Clean Cook stoves [33]			X				X		X	X	Af; LA; C
	Renewable Energy and Energy Efficiency Partnership (REEEP) [34]	X	X	X	X	X	X	X				
	Renewable Energy Policy Network for the 21st Century (REN21) [35]	X	X		X	X		X				
	UN-Energy [36]	X	X	X	X	X		X	X		X	A; AP
International financial institutions	Asian Development Bank (ADB) [37]	X				X	X					A
	African Development Bank (AfDB) [38]					X						Af
	Global Environment Facility (GEF) [39]	X	X	X	X	X	X	X	X		X	Af; LA; MENA
	Inter-American Development Bank (IADB) [40]		X			X	X	X	X		X	LA; C; AP
	World Bank [41]	X	X		X	X	X	X			X	A; Af; E; P; LA, C; B
International research institutions	International Institute for Sustainable Development (IISD) [42]	X			X				X			C; Af; T
	World Resource Institute (WRI) [43]	X			X	X			X		X	
Regional organizations and initiatives	AFREPREN [44]				X			X			X	Af
	Asian Center for Energy (ACE) [45]				X	X					X	AP; T
	Asia-Pacific Partnership on Clean Development & Climate (APP) [46]	X			X	X	X	X	X		X	AP; T
	African Union (AU) [47]	X	X	X	X	X					X	Af
	Clean Energy Ministerial (CEM) [48]		X			X	X				X	M
	ECOWAS Regional Center for Renewable Energy and Energy Efficiency (ECREEE) [49]	X			X		X	X		X		ECOWAS
	Latin American Energy Observatory (OLADE) [50]		X		X						X	LA; C; T
	Regional Center for Renewable Energy and Energy Efficiency (RCREEE) [51]	X		X	X	X	X		X	X		M
	Secretariat of the Pacific Community (SPC) [52]	X	X				X					P; C
	Pacific Regional Environment Program (SPREP) [53]	X			X	X	X	X				SIS
	United Nations Economic Commission for Africa (UNECA) [54]	X			X		X	X	X	X		M
	United Nations Economic Commission for Europe (UNECE) [55]				X	X	X	X			X	M
	United Nations Economic Commission for Latin America and the Caribbean (UNECLAC) [56]	X			X		X					LA; C
	United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP) [57]				X	X	X		X		X	M
	United Nations Economic and Social Commission for Western Asia (UNESCWA) [58]				X	X	X					M
Private Sector Representatives (International Level)	Alliance for Rural Electrification (ARE) [59]		X	X	X	X		X	X			
	Global Wind Energy Council (GWEC) [60]	X	X	X							X	T
	International Hydropower Association (IHA) [61]		X	X								M
	International Solar Energy Society (ISES) [62]	X	X	X		X	X		X			M
	World Bio-energy Association (WBA) [63]	X	X	X		X		X	X	X	X	M
	World Wind Energy Association (WWEA) [64]	X	X	X		X					X	T
Other	National Renewable Energy Laboratory (NREL) [65]	X	X	X	X	X			X	X		A; AP; SIS

Non-Annex I countries to promote clean energy development projects (i.e. Clean Development Mechanism) [66–68]; while non-financial organizations focus on providing information and advice on available financing mechanisms (i.e. UNECA; APP; REEP; REN21; UN ENERGY).

In terms of policy advice and assistance, the contribution of key players varies widely with some only encouraging exchanges about RE policy and its framework conditions while others provide effective advice and assistance. Generally, activities are locally oriented towards a country level as policies are a direct function of the local contexts. Regional organizations tend to be more focused at barriers' analysis and networking (i.e. AFREPREN; ECREEE; UNCLAC) often conducted in support of our partnership with international organizations who focus on enabling environments and occasionally perform reviews and assessments of policy regulations and measures (RECREEE; IEA; IRENA) [66,68]. Many of these bodies have also played an indispensible role in the formulation of RE international policies inside and outside the UN system facilitating the achievement of international commitments of countries under global agreements (i.e. Kyoto Protocol). On another hand, joint research in RE technologies as well as developing standards are being promoted as a means to provide collaboration and guidelines towards uniformity in the RE sector. In closure, the mapping of RE knowledge discerned skewed efforts towards the different facets of RE (Fig. 2) pointing to gaps that remain unaddressed.

3.2. Gap analysis

While globally much effort is invested in the collection of RE related information and knowledge, there is a clear absence of an orderly method to access quality information. The latter is either widely scattered or undisclosed, delaying RE development and maintaining a non-effective RE enabling environment due to the lack of up to date information. For instance, developed countries appear to have limited interest in the flow of information and control what is being shared and with whom. As a result, much information remains non-accessible. With partial information

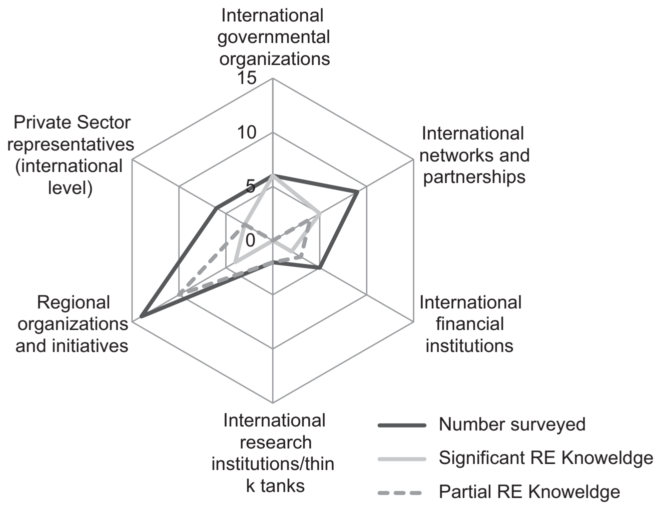


Fig. 1. Contribution of identified organizations to RE knowledge.

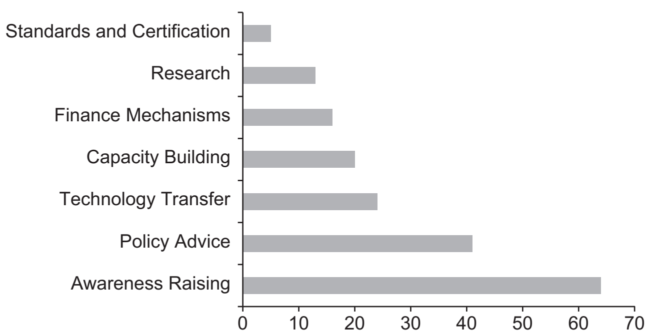


Fig. 2. Relative distribution of efforts on RE related aspects.

sharing, the incomplete realization of RE penetration is expected in developing countries, delaying enabling environments and reducing RE investment potential. Moreover, resources are often lost on duplicate research, information exchange and awareness raising activities already conducted by others or on efforts that do not address the public or interest of local policy makers. Similarly, CB efforts, although widespread, are duplicated irrespective of the countries' needs whereby issues addressed, audiences targeted and impacts remain not evident. Whilst this is common among many RE key players, they can improve their scope, particularly regional organizations, to help achieve local sustainable development and channel CB towards country specific needs.

In terms of technology transfer (TT), efforts are limited mostly to projects implemented in Non-Annex I or developing countries, albeit the questionable appropriateness and impact, since TT does not always come hand in hand with awareness, or may only involve demonstration projects, or is mostly oriented towards small power projects not sprouting from the needs and gaps of recipient countries. It is widely agreed that TT to developing countries consist generally of older or low-end innovation technology which is transferred under two scenarios: in a development package with conditions (tit for tat) or without conditions but with no maintenance, training, or follow-up services mainly because of the lack of will to freely deliver a new technology or perhaps the lack of interest to develop the RE industry in developing countries. Furthermore, while analytic and advisory services to influence policy in developing countries constitute a central contribution of regional organizations, there is a lack of assessment of the impact of suggested policies on the overall RE development and their role in facilitating an RE enabling environment where post-policies evaluation activities are inexistent. Most agencies focus on RE deployment for electricity generation only and to some extent on transmission and heating. As such, it is observed that only 98 countries worldwide have RE targets, with many developing countries lagging behind [6]. The limited evaluation of the impact and effectiveness of projects beyond their lifetime coupled with stringent market regulations between countries are cross cutting gaps that traverse through all RE aspects limiting the transfer and penetration of technologies.

Despite the fact that worldwide financial investments in RE is growing and has crossed over USD 200 billion in 2010 [6], the available financial mechanisms are not developed to make the best use of technological efforts, whereby gaps exist between the demonstration and technology production on one end and their commercialization on the other end. Moreover, there is no RE specific financial mechanism dedicated for RE deployment in terms of procedures and budget with RE projects competing for finances with all other types of projects. The role of the UNFCCC in the indirect financing of RE deployment in Non-Annex I countries through the CDM initiative is noteworthy, albeit with modest outcomes due to procedural complexity and requirements. Similarly, the recent efforts of the UNDP, UNEP and UNIDO towards the Energy Access Facility (EAF) promise to provide finance tools and means, albeit with debatable effectiveness. On another front, although fostering research networks to undertake joint research and develop technical standards is advocated by international and regional organizations, limited efforts are recorded worldwide with lack of coordination between technology producers and those applying it.

Table 3 summarizes the identified gaps which could be traced back to four major precursors: the lack of cooperation and coordination among various actors with similar scope of work on RE, the doubt in the appropriateness of the RE activities conducted by various actors particularly to address local and regional RE needs and demand, the lack of a priority assessment of local status and needs as well as the lack of post-activity assessment of effectiveness. These precursors need to be closely addressed for a proper deployment of RE knowledge and technologies, where proper enabling environments (infrastructure, policy and regulatory frameworks) are still lacking in most developing countries; as a direct result of the unequal geographical distribution of RE related efforts, yet another gap [66].

In addressing the above gaps, it is critical to recognize the absence of a balanced approach for promoting RE technology in developing countries by international and regional RE organizations. In fact, the geographical location and level of involvement of these organizations revealed an imbalanced distribution of efforts and interests that inhibit RE knowledge circulation to developing countries. Fig. 3 indicates that at least four regional organizations are active in each of South Asia and the Pacific, and Central and South Africa while three are active in the Caribbean and East Asia, and two in North Africa, Central Asia and West Asia regions, which possess high potential for RE particularly solar and wind. Similarly, the work of international organizations is disproportionately focused on Africa, Asia and Latin American, and the Caribbean and to a lesser extent on Eastern Europe and the Pacific. Efforts are also unequally distributed among sub-regions whereby in Asia and Africa, the Central, South and East Asia, and the Central and Sub-Saharan Africa receive the lion's share of efforts in the two continents, highlighting the absence of RE efforts in the developing North Africa and Central and West Asia regions, among others.

In summary, developing countries are at a heterogeneous disadvantage with regards to RE knowledge and deployment with international and regional organizations appearing to prioritize their client-countries. For instance, countries with economies in

Table 3
Summary of gap analysis.

Aspect	Identified gap
Information Sharing & awareness raising	– Different actors provide similar information, while other types of information are not provided by any – Data provided are sometimes outdated or not regularly updated – Lack of cooperation leading to duplication of work (conferences, publications…etc.) and losses in resources that can be better oriented – Lack of systematic research RE potential in developing countries
Policy advice and assistance	– Does not address much RE but is focused mainly on electricity – Regional policies stress the "one size fits all policy" and do not always cater for the non-uniformity in local needs of various countries – Lack of systematic follow up and evaluation of effectiveness of policies formulated
Technology Transfer	– Does not cater to country needs rather follow donor agenda – Targeting more economies in transition
Capacity Building	– Does not always address local needs rather follow donor/ trainer agenda – Limited assessment of the impact and effectiveness of CB efforts – Limited expertise and skilled professionals in public institutions
Finance Mechanisms	– Lack of incentives for countries to apply and invest in RE. – Funded projects are influenced by donors agenda – Gaps between technology production and commercialization
Research & Standardization	– Limited concerted efforts towards joint research initiatives – Slow progress towards standardization and certification of RE technologies – Lack of coordination between technology production and application

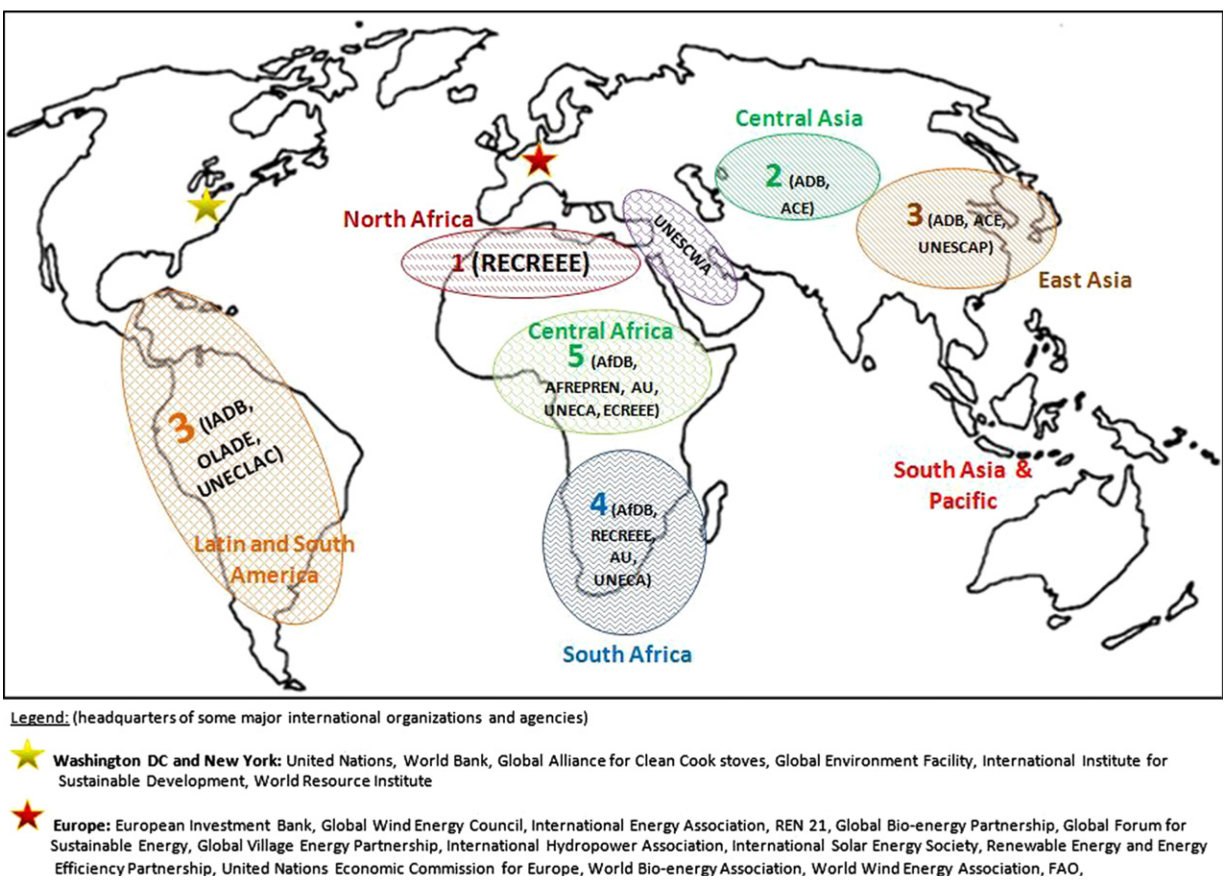


Fig. 3. Distribution of regional organizations.

transition (i.e. China, India, Brazil, Chile and Mexico) have received the greatest interest from international organizations, as pointed out in Fig. 4 depicting an example of global flows of wind energy technology. Evidently, the flows originated exclusively from Europe, Japan and the United States to countries with economies in transition. Voiced interests of countries are more

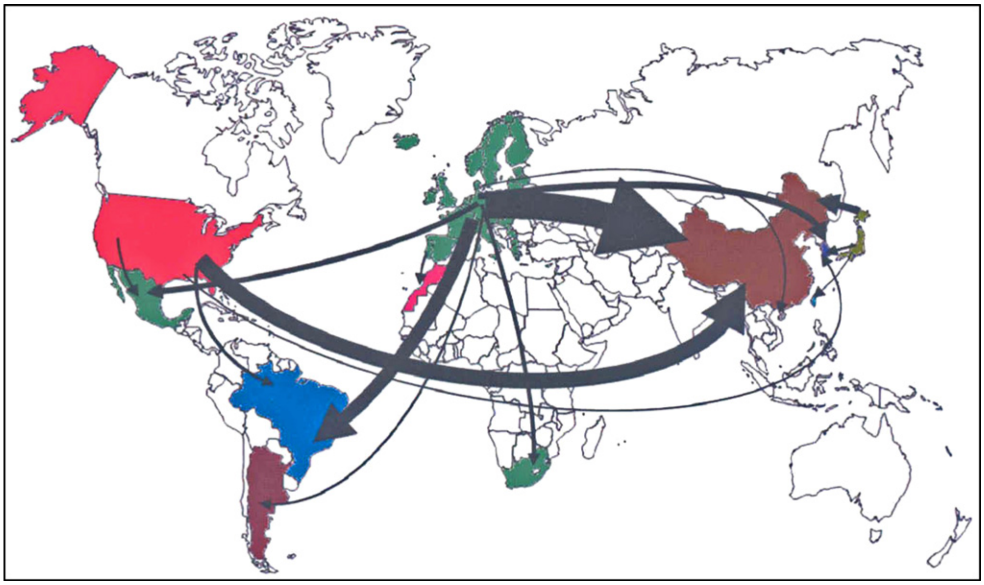


Fig. 4. Wind technology transfer flows (1988–2007) to economies in transition [66].

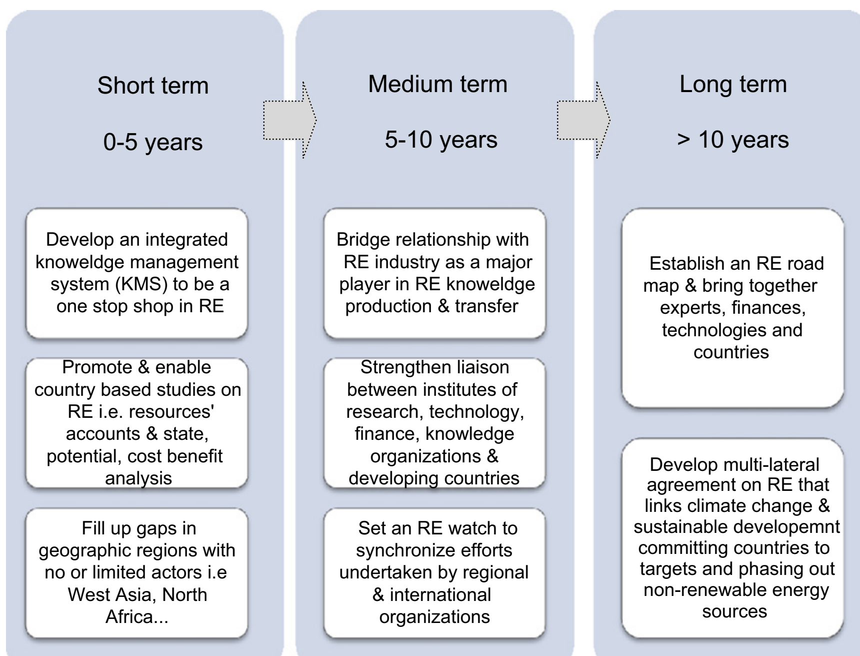


Fig. 5. Proposed framework: non-exhaustive initiatives or programs.

supported than the influence on national interests. The promotion and implementation of RE development plans seem inequitable and can be explained and attributed to geo-political circumstances, benefits of funding organizations or hidden agendas. The inequity prohibits developing countries from equal opportunities to RE access and implementation and increases the gap between developed and developing countries.

3.3. *Framework for the way forward*

Knowledge mapping and gap analysis highlighted the need for a core adjustment of the current trend in RE knowledge circulation and deployment where end of pipe solutions are not effective in bridging knowledge gaps. In effect, a general framework is proposed by defining short-, medium-, and long-term targeted activities or programs as outlined in Fig. 5 to be adopted to consolidate efforts and ensure RE wide deployment targeting and catering for developing countries.

Effective implementation of such a framework requires that a leading entity espouses its responsibility and advances its realization assuming the role of facilitator for developing countries by acting as a liaison between them and technology developers and financial institutions to ensure expert support, best practices exchange, and sufficient finances to implement projects and produce local knowledge. This entity also needs to become more technically involved in closing the gap by acting as an active focal point that has member parties. For this purpose, it is critical to have: an internationally renowned standing of knowledge exchange and facilitation, the ability to convene stakeholders (i.e. experts, finances, technologies, and countries…etc.), the credibility to be trusted by countries, the governance to act on behalf of countries, and the influence to bring about change.

Accordingly, among the wide range of international organizations involved in RE, those with the potential profile to assume the role of the leading entity include: international networks and partnerships (i.e. REEEP, REN21, GFSE, GVEP), intergovernmental agencies (i.e. IEA, IRENA), UN agencies (i.e. UN ENERGY, UNDP, UNEP), and international financial organizations (i.e. WB and GEF). The SWOT analysis identified strengths and weaknesses of promising types of organization (focusing on REEEP, IEA, IRENA, UN ENERGY and WB) in comparison with the desired profile as well as the threats and opportunities based on their mandates, which can support or prevent their selection (Table 4).

Accordingly, while international networks and partnerships are focused on RE, they are weakly connected to beneficiaries, through passive interactions, and do not possess the robustness, influence and legitimacy needed. In contrast, UN agencies are well positioned in terms of legitimacy, power, standing, ability and influence but their involvement in wider environmental and developmental scopes weakens their status. The UN Energy network could be developed to act as the optimal RE leading organization, however, as it stands today, it merely acts as information middleman or interface that provides access to energy related efforts by the various UN agencies. Intergovernmental agencies and international financial organizations possess considerable potential, because of similar legitimacy and credibility as UN agencies, with the latter possessing the advantage of already established energy related initiatives and the considerable financing experience worldwide channeled through capacity building, technology transfer, and policy aid on renewable and sustainable energies that make them competitive candidates. Defining a financial organization such as the WB as the leading organization, capitalizes on its well established and renowned system that can enter into force immediately, however, might induce less effective influence on the long run due to managing multiple developmental portfolios.

In parallel, the international governmental organizations (i.e. IEA and IRENA), despite their unofficial legitimacy, may have considerable weight and standing, given their experience, expertise and efforts exclusively focused on energy. IRENA represents

Table 4
Summary of SWOT analysis for optimal organization profile.

Type	Strengths	Weaknesses	Opportunities	Threats
International networks & partnerships **REEEP**	– Active knowledge platforms (database, portal…) – Address barriers – Build capacities	– Not locally oriented – Mainly advisory services – Outputs mainly online tools, publications – Limited funding mainly to emerging developing countries	– Clearinghouse for policy knowledge – Acts as change agents – Fund barrier identification and barrier removal projects – Advocacy	– Weak link with beneficiaries – Weak assessment of influence – Weak governmental representation
Inter-governmental agencies **IEA**	– Active & reliable information portals – Developed knowledge bases – Policy advisory and assessment of effectiveness – Developed active interactive initiatives	– Not globally developed yet – Operates mainly under OECD	– Involve wide variety of stakeholders – Represent wide array of governments – Exclusively focused on energy (sustainable, renewable, efficiency) – Knowledge clearinghouse – Think Tank	– Do not possess sufficient effective links with beneficiaries on a global level – Not binding to non-members
Inter-governmental agencies **IRENA**	– Established knowledge base – Resource assessment & technology cooperation activities – Policy advisory and CB – Abu Dhabi Development Fund – 91 members and 66 signatories/applicants	– Membership based – Not globally active yet	– Involve wide variety of stakeholders – Represent wide array of governments – Exclusively focused on RE – Seek UN agency status – Knowledge clearinghouse – Think Tank – Based in the developing world i.e. closer to the need	– Do not possess sufficient effective links with beneficiaries on a global level – Not binding to non-members
UN agencies **UN ENERGY**	– Knowledge network – Country focus – Advise on policy – Promote and enable access to sustainable energy – Act as filter of energy data within the UN system	– Mechanism to promote coherence of UN bodies efforts on energy field – Do not act as an independent body in energy field – Act through its lead members UNEP, FAO or UNESCO	– Knowledge clearinghouse – RE components led by FAO, UNEP, or UNESCO i.e. weak centralization – Seek to become a system wide network for multi actors to work with UN	– Involved in the wider energy realm – RE projects are channeled through other UN agencies i.e. increasing bureaucracy
International financial organizations **WB**	– Country focus – Technology transfer, knowledge transfer through considerable worldwide financing	– Main funding channels to economies in transition	– Well established with renowned standing – Regional and country specific programs – Operational leverage – Established energy sector reforms and energy strategies	– Involved in the wider development – Funding RE projects compete with other sustainable development and poverty alleviation projects – Donor oriented agendas (not always country needs' oriented)

Table 5
Summary of knowledge mapping and gap analysis findings.

Knowledge management trends	Knowledge gaps and barriers
– Raising awareness on RE potential & benefits through direct i.e. conferences, meetings … and indirect means i.e publications, databases… – Information sharing particularly on best practices and available technologies at the regional and international level through readily available databases and platforms. – Policy assistance at the three levels of advocacy through barrier analysis and policies' review, exchange through networking and enabling through policy formulation, particularly promoted by regional organizations. – Capacity building through training and education i.e. GREET of UNESCO and WB toolkit at the international level. – Efforts that facilitate technology transfer including demonstration projects and technical assistance coupled with information sharing and financing mechanisms.	– Duplication of efforts – Limited, if any, follow up on the impact of projects beyond project lifetime – Lack of evaluation of effectiveness of efforts related to capacity building or policy formulation – Stringent market regulations between countries that limit the open transfer and penetration of technologies – A general lack of enabling environments in developing countries particularly due to the lack of infrastructure for RE, policy and regulatory frameworks – Geographically unequal distribution of RE related efforts where much have been invested in economies in transition and not widely in developing countries.

an interesting sole case of an RE focused international governmental organization with increasing number of signatories (66) and parties (91) emerging as an ambitious strong player in RE knowledge and deployment at the international level. It has a clear mission to 'promote the widespread and increased adoption of and the sustainable use of all forms of renewable energy' and have initiated efforts towards all forms of RE knowledge management including technology cooperation, renewable readiness assessment, global atlas for renewable energy, and financing mechanisms. With its Secretariat based in Abu Dhabi, a developing country, it may attain increased acceptance among developing countries with a promising future as it currently seeks UN standing for global stature and legitimacy. Giving the lead to a recent intergovernmental organization such as IRENA, although requires significant pre-requisite organizational and structural changes for increased legitimacy and credibility, capitalizes on its dedication and commitment towards RE to mold a new high standing international organization exclusively mandated towards RE enhancement and wider deployment.

4. Conclusion

The evolvement of RE capacity in developing countries has been closely linked to the aid provided by developed countries and international and regional organizations and hence is a function of the scope, scale and effectiveness of such aid. A knowledge mapping of key players in the RE sector with their corresponding roles and activities followed by a gap analysis identified main trends in RE knowledge management and the multiple knowledge barriers (Table 5).

A general framework is proposed defining short-, medium-, and long-term activities through which an RE focused international organization would aspire to become a leading center and a platform for RE exchange and development to organize, guide and ensure effective RE deployment. The SWOT analysis identified potential opportunities and strengths among existing international organizations that could be capitalized on to bridge identified gaps and facilitate the RE knowledge spread through the proposed framework, particularly in developing countries.

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